We Claim:

1. An apparatus for intermittent contact imaging comprising:

a sensor to contact intermittently a sample to be imaged and generating displacement signals during oscillation thereof;

a scanner adjacent said sensor and supporting said sample to be imaged, said scanner being actuable to move said sample relative to said sensor to bring said sensor into intermittent contact with said sample; and

a controller in communication with said sensor and said scanner, said controller including a sensor feedback circuit receiving said displacement signals and an AC setpoint signal, said AC setpoint signal having a frequency generally equal to the frequency at the peak of the displacement versus frequency curve of said sensor, the output of said sensor feedback circuit being applied to said sensor to oscillate the same, said controller further providing output to said scanner in response to said displacement signals to control the separation distance between said sensor and said sample.

2. An apparatus as defined in claim 1 wherein said sensor feedback circuit is adjusted such that said displacement signals are generally in-phase with said AC setpoint signal at the frequency where the open loop gain of said sensor feedback circuit falls generally to one.

3. An apparatus as defined in claim 2 wherein said sensor feedback circuit includes a summing junction summing said AC setpoint signal and said displacement signals, a control block having a good low frequency response receiving the output of said summing junction and generating feedback signals and a high-pass junction to supply said feedback signals to said sensor.

4. An apparatus as defined in claim 3 wherein said summing junction is constituted by a summing amplifier and wherein said control block is a proportional-integral-derivative controller.

5. An apparatus as defined in claim 4 wherein during adjustment of said sensor feedback circuit, electronic gains of the integrator and differentiator of said proportional-integral-derivative controller are adjusted.

6. An apparatus as defined in claim 5 wherein oscillations of said sensor are detected by an RF capacitance bridge established at said sensor, said capacitance bridge generating said displacement signals.

7. An apparatus as defined in claim 6 wherein said sensor includes a common plate supported by oppositely extending torsion bars above a pair of electrodes and carrying a tip to contact said sample, said electrodes being driven by high frequency signals to establish said RF capacitance bridge and being driven by said feedback signals to cause said common plate to oscillate.

8. An apparatus as defined in claim 7 wherein said tip is secured to said common plate by conductive adhesive and has a generally parabolic configuration.

9. An apparatus as defined in claim 4 further including a demodulator to demodulate and low pass filter said displacement signals before said displacement signals are conveyed to said summing amplifier.

10. An apparatus as defined in claim 9 further including a preamplifier disposed between said sensor and said demodulator.

11. An apparatus as defined in claim 10 further including an amplitude and phase detector and an image feedback controller, said amplitude and phase detector

receiving the output of said demodulator and providing output signals to said image feedback controller, said image feedback controller being responsive to said amplitude and phase detector and controlling the actuation of said scanner to maintain the oscillation displacement of said sensor generally at a constant.

12. An apparatus as defined in claim 11 further including an analog to digital converter receiving said feedback signals, phase signals from said amplitude and phase detector and error signals from a scanner feedback circuit and providing output to an imager, said imager generating images of said sample in response to said signals.

13. An apparatus as defined in claim 2 wherein the frequency of said AC setpoint signal has a frequency equal to the frequency at the peak.

14. An apparatus as defined in claim 13 wherein said feedback circuit behaves similar to a second-order, low-pass filter.

15. An interfacial force microscope comprising:

a differential-capacitance displacement sensor having a tip mounted on an oscillating member, said sensor generating displacement signals during oscillation of said member;

a scanner adjacent said sensor and supporting a sample to be imaged, said scanner being actuable to move said sample relative to said sensor to bring said tip into intermittent contact with said sample and to move said sample relative to said sensor to raster said sensor over said sample; and

a controller in communication with said sensor and said scanner, said controller including a sensor feedback circuit receiving said displacement signals and an AC setpoint signal, said AC setpoint signal having a frequency generally equal to the frequency at the peak of the displacement versus frequency curve of said sensor, the output of said sensor feedback circuit being applied to said sensor to oscillate the

same, said controller further providing output to said scanner in response to said displacement signals to control the separation distance between said sensor and said sample.

16. An interfacial force microscope as defined in claim 15 wherein said sensor feedback circuit is adjusted such that said displacement signals are generally in-phase with said AC setpoint signal at the frequency where the open loop gain of said sensor feedback circuit falls generally to one.

17. An interfacial force microscope as defined in claim 16 wherein said displacement sensor includes a common plate supported by oppositely extending torsion bars above a pair of electrodes and carrying a tip to contact said sample, said electrodes being driven by high frequency signals to establish said RF capacitance bridge and being driven by said feedback signals to cause said common plate to oscillate, said RF capacitance bridge detecting changes in capacitance between said common plate and electrodes and generating said displacement signals.

18. An interfacial force microscope as defined in claim 17 wherein said feedback circuit sums said low frequency signal and said displacement signal to generate an error signal, said error signal being used to generate the feedback signals to cancel rotational tendencies of said common plate.

19. An interfacial force microscope as defined in claim 18 wherein said sensor feedback circuit includes a summing junction summing said low frequency signal and said displacement signal, a control block having a good low frequency response receiving the output of said summing junction and generating said feedback signals and a high-pass junction to supply said feedback signals to said sensor.

20. An apparatus as defined in claim 19 wherein during adjustment of said sensor feedback circuit, electronic gains of the integrator and differentiator of said proportioned-integral-derivative controller are adjusted.

21. An interfacial force microscope as defined in claim 15 wherein the frequency of said AC setpoint signal has a frequency equal to the frequency at the peak.

22. An interfacial force microscope as defined in claim 21 wherein said feedback circuit behaves similar to a second-order, low-pass filter.

23. A method of imaging a sample surface comprising the steps of:

oscillating a sensor at a driven setpoint frequency to cause said sensor to intermittently contact a sample to be imaged;

generating displacement signals in response to oscillations of said sensor;

moving the sample relative to said sensor to maintain the separation distance between said sensor and sample; and

rastering said sensor over the sample surface, wherein said driven setpoint frequency is generally equal to the frequency at the peak of the frequency versus displacement curve of said sensor.